3.6 What is implicit differentiation?
3.7 How to use implicit differentiation to get an equation of *rates of change?*

2014-10-28 day 44

fire drill spot: 18C

Assume that oil from a ruptured tanker spreads in a circular pattern, radius increases at a constant rate of 2 ft/s. How fast is the area of the spill increasing when $\boxed{r=60 \text{ ft}}$?

1) picture
2) equation always true $A=\pi r^2$
3) derivatives with respect to time always true. $\frac{dA}{dt}=\pi\left(2r\frac{dr}{dt}\right)$
4) substitute in for specific instant. $\frac{dA}{dt}=\pi(2\cdot 60\cdot 2)$
5) answer d*** question

$\boxed{\frac{dr}{dt}=2 \frac{\text{ft}}{\text{sec}}}$

assuming that A, r are functions of time.

$$\frac{dA}{dt}=240\pi\frac{\text{ft}^2}{\text{sec}}$$

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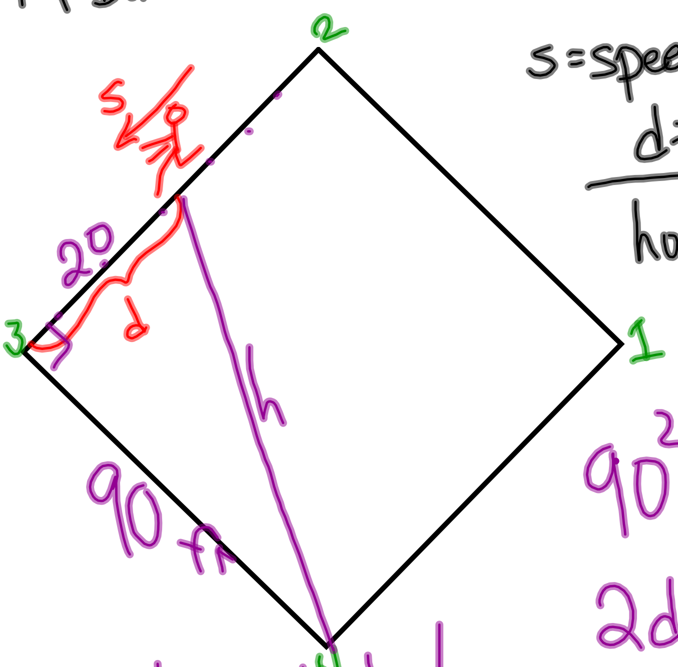
2014-10-28 day 44

fire drill spot: 18C

A baseball diamond is a square 90 ft × 90 ft



s = speed is 30 ft/sec when
d = 20 ft.

how fast is the distance from home changing at that instant?

$90^2 + d^2 = h^2$ (true for every time t)

$2d\left(\frac{dd}{dt}\right) = 2h\left(\frac{dh}{dt}\right)$

have? -30 ft/sec

need to find

At the instant,
$h^2 = 90^2 + 20^2$
$h = \sqrt{8500}$

$2(20)(-30) = 2\sqrt{8500}\,\frac{dh}{dt}$

$\frac{-60}{\sqrt{85}}\,\frac{ft}{sec} = \frac{-600}{\sqrt{8500}}\,\frac{ft}{sec} = \frac{dh}{dt}$

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2014-10-28 day 44

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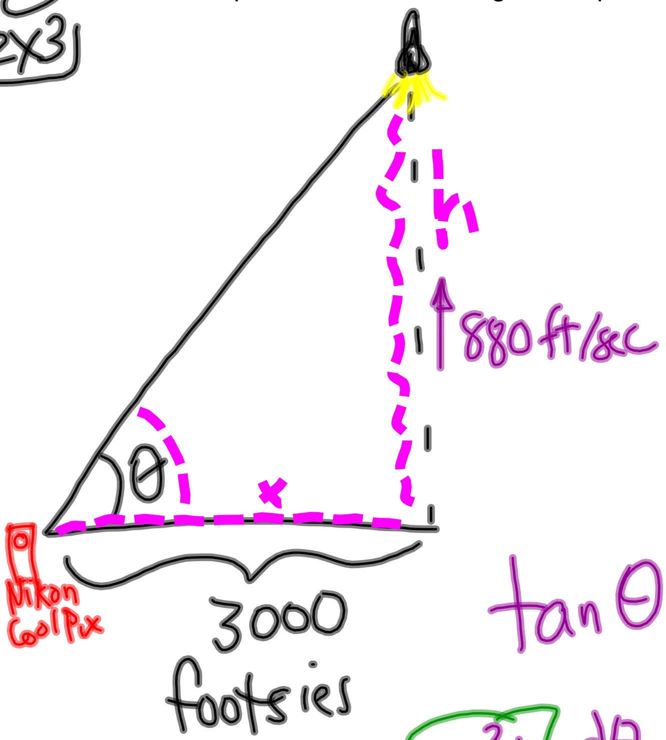
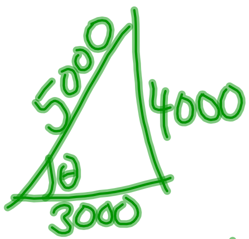
ex3)



how fast must the camera's elevation angle be changing when the rocket is rising @ 880 ft/sec when it is 4000 ft high?

$$\tan\theta = \frac{h}{3000}$$

$$\boxed{\sec^2\theta}\cdot\frac{d\theta}{dt} = \frac{1}{3000}\frac{dh}{dt} \qquad \frac{dh}{dt} \to 880\ \frac{ft}{sec}$$



$$\sec\theta = \frac{1}{\cos\theta} = \frac{hyp}{adj} = \frac{5000}{3000} = \frac{5}{3}$$

$$\sec^2\theta = \frac{25}{9}$$

$$\frac{25}{9}\cdot\frac{d\theta}{dt} = \frac{1}{3000}(880)$$

$$\frac{d\theta}{dt} = \frac{\overset{3}{\cancel{9}}\cdot 88\cancel{0}}{25\cdot\cancel{3}00\cancel{0}} = \frac{3\cdot 88}{25\cdot 100}$$

$$\frac{d\theta}{dt} = \frac{3\cdot 22}{25\cdot 25}\ \frac{radian}{sec}$$

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2014-10-28 day 44

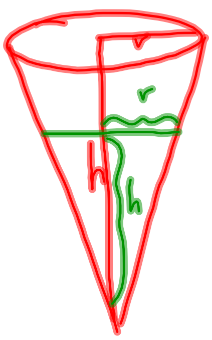
fire drill spot: 18C

ex 4) Suppose that liquid is to be cleared of sediment by draining thru a conical filter, that is 16 cm high and has a radius of 4cm at the top. Liquid flows out of the cone at a constant rate of $2\ cm^3/min$.

a) will depth decrease at a constant rate?

b) find formula that expresses the rate at which depth is changing in terms of depth. [use this to verify a]

c) At what rate is depth changing when liquid is 8cm deep?



$$V = \text{Area}_{\text{base}} \cdot \text{height} = (\pi r^2)h \quad \text{cylinder}$$

$$V = \frac{1}{3}(\pi r^2)h \quad \text{cone}$$

$$\frac{4}{16} = \frac{r}{h}$$

$$\boxed{\begin{array}{c} h = 4r \\ \frac{1}{4}h = r \end{array}}$$

Wilder is cool.